

## IN THE CLAIMS

What is claimed is:

- 1 1. A computer software product including one or more recordable media having  
2 executable instructions stored thereon which, when executed by a processing  
3 device, causes the processing device to:  
4 strengthen a first antecedent label for an edge in an assertion graph.
- 1 2. The computer software product recited in Claim 1 which, when executed by a  
2 processing device, further causes the processing device to:  
3 abstract a second antecedent label to produce the first antecedent label.
- 1 3. The computer software product recited in Claim 1 wherein strengthening the  
2 antecedent label comprises causing the processing device to:  
3 join any pre-images for antecedent labels of outgoing edges from the  
4 edge in the assertion graph; and  
5 keep in the strengthened antecedent label for the edge only what is  
6 already contained by the first antecedent label for the edge and also  
7 contained by the joined pre-images for antecedent labels of outgoing edges  
8 from the edge.
- 1 4. The computer software product recited in Claim 1 which, when executed by a  
2 processing device, further causes the processing device to:  
3 compute a simulation relation for the edge from the strengthened  
4 antecedent label; and

5           compare the simulation relation for the edge to a consequence label for  
6   the edge.

1   5. The computer software product recited in Claim 4 wherein computing the  
2   simulation relation comprises causing the processing device to:

3           identify in the strengthened antecedent label of the edge any states that  
4   are also contained by a post-image for a simulation relation of an edge  
5   incoming to the edge in the assertion graph; and

6           join to the simulation relation for the edge, the identified states.

1   6. The computer software product recited in Claim 4 wherein comparing the  
2   simulation relation to a consequence label comprises causing the processing  
3   device to:

4           determine whether the simulation relation for the edge is contained by the  
5   consequence label for the edge.

1   7. The computer software product recited in Claim 4 wherein comparing the  
2   simulation relation to a consequence label comprises causing the processing  
3   device to:

4           negate a Boolean expression of the simulation relation for the edge, and:

5           logically combine the negated Boolean expression with a Boolean  
6   expression of the consequence label for the edge using a logical OR  
7   operation.

1   8. The computer software product recited in Claim 4 wherein computing a  
2   simulation relation for the edge from the strengthened antecedent label  
3   comprises causing the processing device to:

4           compute a simulation relation abstraction for the edge; and  
5           concretize the simulation relation abstraction for the edge to produce the  
6           simulation relation for the edge.

1   9. The computer software product recited in Claim 8 wherein computing a  
2       simulation relation for the edge from the strengthened antecedent label  
3       further comprises causing the processing device to:

4           abstract the strengthened antecedent label to produce an antecedent  
5           label abstraction for the edge; and  
6           use the antecedent label abstraction to compute the simulation relation  
7           abstraction for the edge.

1   10. A method comprising:

2           strengthening a first antecedent label for an edge in an assertion graph; ..

1   11. The method recited in Claim 10 wherein strengthening the antecedent label  
2       comprises:

3           joining pre-images of antecedent labels of any outgoing edges from the  
4           edge in the assertion graph; and  
5           keeping, in the strengthened antecedent label for the edge, states already  
6           contained by the first antecedent label for the edge and also contained by the  
7           joined pre-images of antecedent labels of any outgoing edges from the edge.

1   12. The method recited in Claim 10 wherein the first antecedent label is one of a  
2       plurality of antecedent labels including a second antecedent label encoded  
3       along with the first antecedent label into a third antecedent label by a  
4       symbolic indexing function.

- 1 13. The method recited in Claim 10 further comprising:  
2       computing a simulation relation for the edge from the strengthened  
3       antecedent label; and  
4       comparing the simulation relation for the edge to a consequence label for  
5       the edge.
- 1 14. The method recited in Claim 13 wherein comparing the simulation relation to  
2       a consequence label comprises:  
3       determining whether the simulation relation for the edge is contained by  
4       the consequence label for the edge.
- 1 15. The method recited in Claim 13 wherein comparing the simulation relation to  
2       a consequence label comprises:  
3       negating a Boolean expression of the simulation relation for the edge,  
4       and:  
5       logically combining the negated Boolean expression with a Boolean  
6       expression of the consequence label for the edge using a logical OR  
7       operation.
- 1 16. A method comprising:  
2       computing a first simulation relation for an edge in a first assertion graph  
3       from a first antecedent label for the edge;  
4       computing a second simulation relation for the edge from a concretization  
5       function applied to the first simulation relation for the edge; and  
6       comparing the second simulation relation for the edge with a

consequence label for a corresponding edge in a second assertion graph to see if the second simulation relation is contained by the consequence label.

17. The method recited in Claim 16 further comprising:

computing the first antecedent label as an abstraction of a second antecedent label for the corresponding edge in the second assertion graph.

18. The method recited in Claim 17 further comprising:

computing the second antecedent label by strengthening a third antecedent label for the edge in the second assertion graph.

19. The method recited in Claim 16 further comprising:

computing a third antecedent label for the edge in the first assertion graph as an abstraction of a second antecedent label for the corresponding edge in the second assertion graph; and

computing the first antecedent label by strengthening the third antecedent label for the edge in the first assertion graph.

20. A verification system comprising:

means for strengthening an first antecedent label for an edge in an assertion graph;

21. The verification system of Claim 20 wherein the means for strengthening the antecedent label comprises:

means for joining any pre-images for antecedent labels of outgoing edges from the edge in the assertion graph; and

means for keeping, in the strengthened antecedent label for the edge, states already contained by the first antecedent label for the edge and also

7 contained by the joined pre-images for antecedent labels of outgoing edges  
8 from the edge.

1 22. The verification system of Claim 20 wherein the first antecedent label is one  
2 of a plurality of antecedent labels including a second antecedent label  
3 encoded along with the first antecedent label into a third antecedent label by  
4 a symbolic indexing function.

1 23. The verification system of Claim 20 further comprising:

2 means for computing a simulation relation for the edge from the  
3 strengthened antecedent label; and

4 means for comparing the second simulation relation for the edge with a  
5 consequence label for a corresponding edge in a second assertion graph to  
6 check if the second simulation relation is contained by the consequence  
7 label.

1 24. The verification system of Claim 23 wherein the means for comparing the  
2 simulation relation to a consequence label comprises:

3 means for determining whether the simulation relation for the edge is  
4 contained by the consequence label for the edge.

1 25. A verification system comprising:

2 means for computing a first simulation relation for an edge in a first  
3 assertion graph from a first antecedent label for the edge;

4 means for computing a second simulation relation for the edge from a  
5 concretization function applied to the first simulation relation for the edge; and

6 means for comparing the second simulation relation for the edge with a

consequence label for a corresponding edge in a second assertion graph to see if the second simulation relation is contained by the consequence label.

26. The verification system of Claim 26 further comprising:

means for computing the first antecedent label as an abstraction of a second antecedent label for the corresponding edge in the second assertion graph.

27. The verification system of Claim 27 further comprising:

means for computing the second antecedent label by strengthening a third antecedent label for the edge in the second assertion graph.

28. The verification system of Claim 26 further comprising:

means for computing a third antecedent label for the edge in the first assertion graph as an abstraction of a second antecedent label for the corresponding edge in the second assertion graph; and

means for computing the first antecedent label by strengthening the third antecedent label for the edge in the first assertion graph.

29. A verification system comprising:

a recordable medium to store executable instructions;

a processing device to execute instructions; and

a plurality of executable instructions that when executed by the processing device, cause the processing device to strengthen a antecedent label for an edge in an assertion graph.

30. The verification system of Claim 4 wherein the plurality of executable

instructions, when executed by the processing device, further cause the

- 3        processing device to:
- 4            compute a first simulation relation for the edge; and
- 5            concretize the first simulation relation computed for the edge to produce a
- 6        second simulation relation for the edge.